Rice University
Civil and Environmental Engineering

CEVE 420/520 – ENVIRONMENTAL REMEDIATION AND RESTORATION

FALL 2016 Syllabus

Course objective

The objective of this class is to provide you with the knowledge of the processes, chemicals, technologies, and institutional considerations that you need to select an appropriate method for cleaning up contaminated soil, groundwater, sediment, and surface water.

Textbooks

Practical Design Calculations for Groundwater and Soil Remediation, Second Edition by Jeff Kuo, CRC Press; June 2, 2014, ISBN-10: 1466585234.

I will also give you technical papers, other book extracts, and reading assignments from time to time. We will also make extensive use of internet resources. I will include the relevant internet links in the lecture notes. Lecture slides will be usually be distributed before each lecture in hard copy, and all lectures will be posted to Owl-Space.

Grading

Exams (2)	40%
Homework	20%
Group Report	20%
Final (not comprehensive)	20%

Exams

Two closed-book exams will be given in class. The first exam is tentatively scheduled for October 3, and the second is tentatively scheduled for November 7. Both exams will be mostly qualitative with short answers to test your knowledge of specific issues and your understanding of key concepts. There will also be some brief quantitative exam questions to make sure that you know how to apply some of the principles taught.

The final exam will be not be comprehensive and similar to the first two exams.

Homework

Homework assignments will generally be due 1 to 2 weeks after distribution. Assignments and solutions will be posted on Owl-space. Grades on late homework assignments will be reduced by 10 percent of the possible homework grade for each day or part of day that they are late. Homeworks focus on quantitative calculations typical of remediation projects. Extensions can be given *with prior arrangement*.

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Team Report

Each student team will prepare a design report on a key topic covered in the class. The report will consist of a conceptual design of a site remediation project. Key elements of the report will include:

- A background section explaining the issue and technical approach;
- How cleanup levels were established;
- A description of the technology selection process;
- A detailed description of the selected technology;
- A preliminary conceptual design, in the form of text and rough drawings, that illustrate the major design components;
- Calculations to support estimates of materials, labor, and capital needs as well as technical performance;
- A preliminary cost estimate and schedule.

Field trip to Industrial Site

We will take a field trip to an industrial site to see monitoring wells and see active groundwater extraction systems, time permitting. The trip is tentatively scheduled for late October or after the first cold front passes through, but the date is subject to change based on student commitments, weather, and plant activities.

Instructor and Office Hours

Phillip C. de Blanc, Ph.D., P.E.
Lecturer in Civil and Environmental Engineering
107 Mech Lab
Phone: 713-348-4725
Mobile: 281-635-6069 (Emergencies only please!)
Email: pcdeblanc@rice.edu

Office hours 9:00 to 10 a.m. MW and by appointment.

I check email regularly, and you are encouraged to communicate by email whenever possible. I will usually respond within a few hours, but never more than 24 hours later (except on weekends and holidays).

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1. Introduction - Why clean up the environment?
2. Overview of environmental contamination
    a. Sources and Extent of Chemical Contamination in the U.S. and World
    b. Types of sites
    c. Types of Media Affected with examples
    d. Classes of chemical contaminants
    e. Physical nature of contaminants (dissolved, NAPLs, etc.)
3. Site Investigation
    a. Objectives – ID nature, magnitude, and extent of impacts
    b. Conceptual model
    c. Preliminary assessment
    d. Field investigation techniques
    e. Field testing techniques (slug tests, pumping tests, tracer tests)
    f. Laboratory analyses
    g. Assessing extent of impacted media (interpolation techniques, etc.)
4. Risk Assessment
    a. Fundamentals – dose, pathways
    b. Carcinogenic and non-carcinogenic risk considerations
    c. Forward calculations – determining risk from a site.
    d. Backward calculations – calculating cleanup levels
    e. Statistical methods for cleanup
5. Chemical and Physical Properties Affecting Remediation Technologies
    a. Media Characteristics
    b. Chemical Characteristics
    c. Institutional
6. Remediation objectives and classification of technologies
    a. Remediation Objectives
    b. Classification of Remediation Technologies
7. Technologies for Soil Remediation
8. Technologies for Groundwater Remediation
    a. Groundwater extraction
    b. Ex-situ groundwater treatment
    c. In-situ groundwater treatment
    d. Containment
9. Selection of remedial alternatives
    a. Sources of information on remediation technologies
    b. Factors to consider
    c. Presumptive remedies
    d. Technology evaluation
    e. Assembling technologies into complete alternatives
    f. Criteria for evaluation of alternatives
10. Remediation Design Elements
    a. Treatability testing
    b. Supplementary investigations
    c. Design
    d. Use of models
    e. Cost Optimization
    f. Long-term monitoring/sustainability

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Day	Date	Week	Class	Subject
Mon	22-Aug	1	1	First Day of Class Introduction
Wed	24-Aug	1	2	Contaminants/Site Investigations
Mon	29-Aug	2	3	Site Investigations Guest Lecture – Site Investigation Field Techniques
Wed	31-Aug	2	4	Risk Assessment
Mon	**5-Sep**	**3**		**Labor Day - No Class**
Wed	7-Sep	3	5	Chemical, Physical Properties
Mon	12-Sep	4	6	Soil remediation
Wed	14-Sep	4	7	Classes of remediation technologies Guest Lecture - Risk Assessment
Mon	19-Sep	5	8	Soil remediation technologies
Wed	21-Sep	5	9	Soil remediation technologies
Mon	26-Sep	6	10	Soil remediation technologies
Wed	28-Sep	6	11	Focus: soil vapor extraction Guest Lecture: SVE Design
Mon	**3-Oct**	**7**	**12**	**Exam No. 1**
Wed	5-Oct	7	13	Groundwater remediation
Mon	10-Oct	8		**Mid-Term Recess No Class**
Wed	12-Oct	8	14	Groundwater remediation technologies
Mon	**17-Oct**	**9**	15	Groundwater remediation technologies
Wed	19-Oct	9	16	Groundwater remediation technologies

Day	Date	Week	Class	Subject
Mon	24-Oct	10	17	Focus: engineered bioremediation Guest Lecture – In-Situ Bio Design
Wed	26-Oct	10	18	Selection of remedial technologies
Mon	31-Oct	11	19	Remediation design elements
Wed	**2-Nov**	**11**	20	**Field Trip**
Mon	**7-Nov**	**12**	21	**Exam No. 2**
Wed	9-Nov	12	22	Surface water resources (Bedient)
Mon	14-Nov	13	23	Surface Water/Sediments (Bedient)
Wed	16-Nov	13	24	River restoration (Bedient)
Mon	21-Nov	14	25	River restoration (Bedient)
Wed	23-Nov	14	26	Low impact development (Bedient)
Mon	28-Nov	15	27	Low impact development (Bedient)
Wed	30-Nov	15	28	Last day of class (open)
Thu	3-Dec			Start of study period
Sun	6-Dec			End of study period
Mon	7-Dec			First day of finals
Mon	14-Dec			Last day of finals
Mon	21-Dec			Grades due